State of CERES

Norman G. Loeb
NASA Langley Research Center, Hampton, VA

CERES Science Team Meeting, October 29-31, 2013
Scripps Institution of Oceanography, La Jolla, CA

CERES Meeting Objectives

1) CERES Instrument, Algorithm and Validation Status:

- Status of NASA & CERES Project
- CERES Terra, Aqua and SNPP SW/LW/TOTAL Channel Calibration Update
- CERES FM6 and RBI Update
- CERES SNPP SSF Edition-1: VIIRS Cloud Algorithm Status
- CERES GEO Cloud Algorithm Status
- CERES Edition-4 ADM Development status
- SOFA, SARB and TISA Working Group Reports
- Data Management Team Update: Terra/Aqua/SNPP
- Atmospheric Sciences Data Center (ASDC) Update
- CERES Education Outreach

2) Invited Presentations Session

3) Contributed Science Presentations

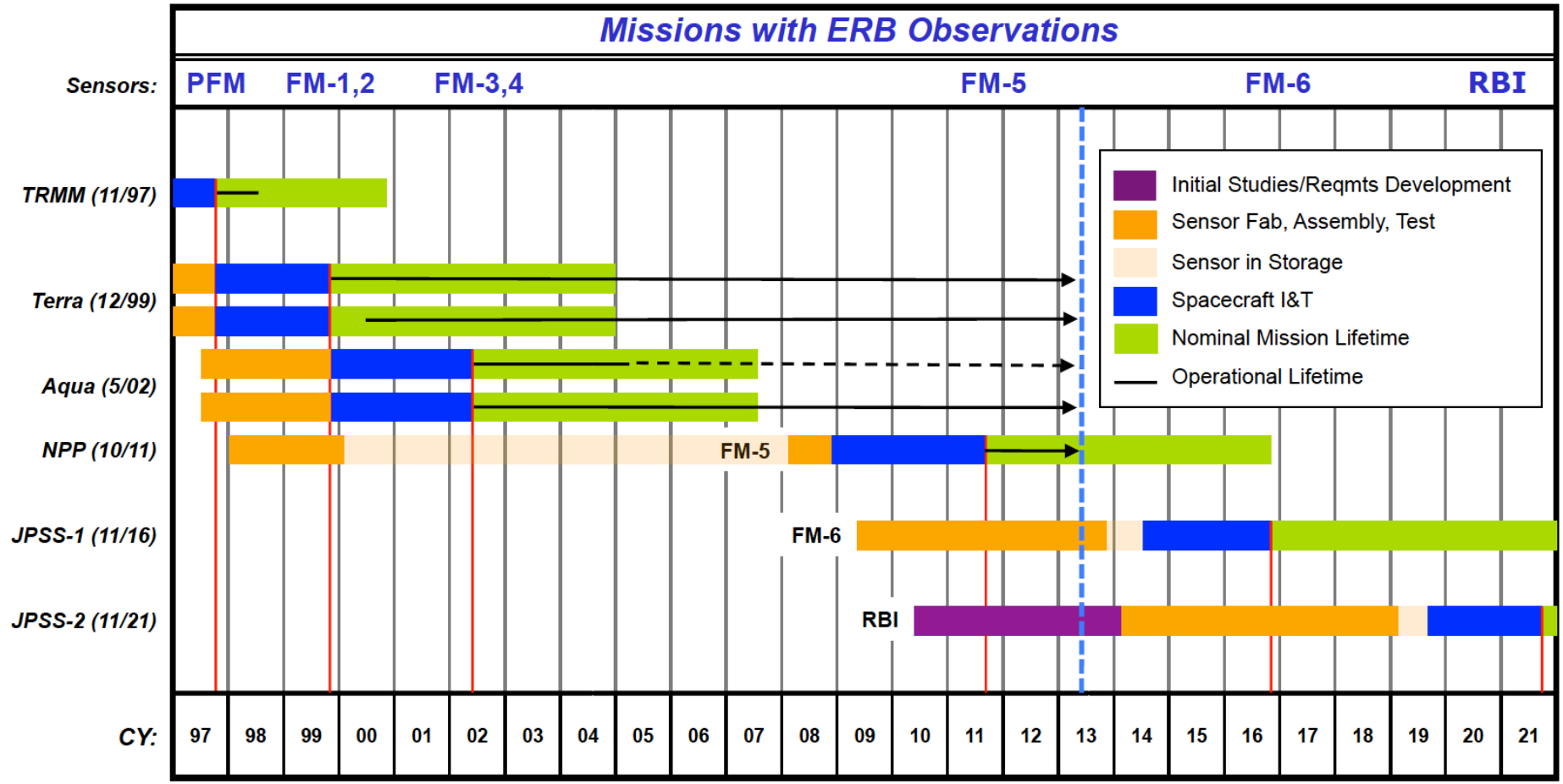
CERES Team Leads

- Principal Investigator: Norman Loeb
- Project Scientist: Kory Priestley

CERES Working Groups:

- Instrument: Kory Priestley
- ERBElike: Takmeng Wong
- Clouds: Pat Minnis
- Inversion: Wenying Su
- SOFA: David Kratz
- SARB: Seiji Kato
- TISA: David Doelling
- FLASHFlux: Paul Stackhouse & David Kratz
- Data Management: Chris Harris (Acting)
- ASDC: John Kusterer

CERES Flight Schedule



- Five CERES instruments on 3 satellites (Terra, Aqua, SNPP) are flying.
- FM6 will be fly on JPSS-1 in 2016 and the CERES Follow-on (RBI) will fly on JPSS-2 in 2021.

2013 Terra and Aqua Senior Review

- Proposal to continue missions for next 2 years
- Science highlights involving CERES and other Terra & Aqua instruments
- Publication, citation, processing and distribution metrics
- Health of CERES Instruments
- Summary of FY12-13 accomplishments, FY14-15 plans and budget, projection for FY16-17

Schedule

Proposal due: March 2013

Panel meeting: May 1, 2013

Publication of the panel's report: June 2013

New budget guidelines and instructions to projects: July 2013

Projects revised implementation plans to ESD: August 2013

2013 Terra and Aqua Senior Review

Specific CERES Themes:

- Accomplishments during past 2 years. Plans for next 2 years.
- Continue to monitor instrument health, safety and performance.
- Continue Edition3 processing.
- Complete Edition 4 algorithm improvements, validation studies.
- Improving efficiency of producing CERES data products (e.g., CATALYST).
- Improving efficiency of validation approach by exploiting CERES subsetting/visualization tool.
- Overhaul of CERES ERBE-Like using ANN approach.

Senior Review Panel Scores

Mission	Science Scores			Summary Science Score	Utility Score	Technical Risk	Conclusion	
	Merit	Relevance	Product Maturity				FY14-15	FY16-17
ACRIMSAT	4.0	4.2	2.8	3.7	Some	Medium-Low	Continue	Continue
Aqua	5.0	5.0	4.7	4.9	Very High	Medium	Continue	Continue
Aura	5.0	5.0	4.9	5.0	High	Medium-High	Continue	Continue
CALIPSO	5.0	5.0	4.9	5.0	High	Medium	Continue	Continue
CloudSat	5.0	5.0	4.9	5.0	High	Medium-High	Continue	Continue
EO-1	4.0	4.3	3.0	3.8	Some	Medium-High	Continue	Terminate & Close out*
GRACE	5.0	5.0	4.0	4.7	High	High	Continue	Continue
Jason-1	5.0	5.0	5.0	5.0	High	Medium-High	Continue	Continue & Reduce*
OSTM	5.0	5.0	5.0	5.0	High	Low	Continue	Continue
QuikSCAT	5.0	5.0	5.0	5.0	High	High	Continue	Continue
SORCE	4.9	5.0	3.2	4.4	High	High	Continue	Continue
Terra	5.0	5.0	4.8	4.9	Very High	Medium-Low	Continue	Continue
TRMM	5.0	5.0	5.0	5.0	Very High	High	Continue	Continue

Table 1: Summary of mission-specific findings. All science scores are on a 1-5 scale with 1 being the lowest ranking of "poor" and 5 being the highest ranking of "excellent". *Additional commentary or conditions on the panel's scores and/or conclusions are noted in the mission findings summary below.

Phase F Close-Out Plan

- Describe and provide budget for activities that would be needed in FY2014 and FY2015 in the event that the data flow from Terra and/or Aqua were to terminate on October 1, 2013.

- The following is a list of new activities that will need to be performed during close-out:

1) Catalog and prepare all pre-launch instrument reports for archiving.

2) Prepare Instrument Operations documentation collected during mission for archiving. Much of this is available in CERES web pages.

3) Collect, archive and catalogue data documentation for all publically distributed CERES data products. Includes CERES Data Quality Summaries, sample read software, Readme files, etc., and other relevant documents (journal articles, technical reports, etc.).

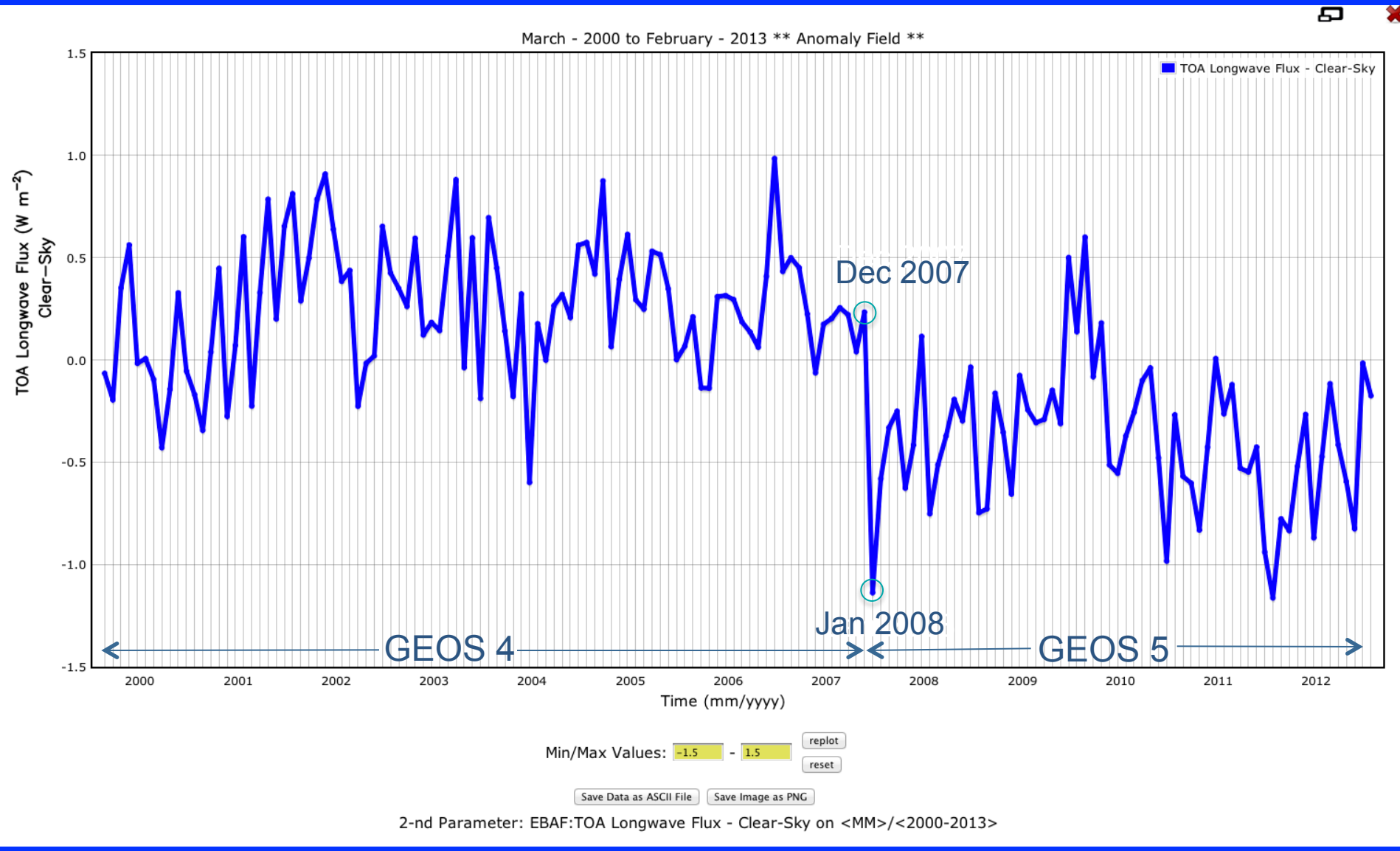
4) Update software documentation and archive latest version of level 1-3 code and ancillary input data used prior to mission termination so that code can be run at a later date should the need arise (e.g., for comparison purposes during subsequent reprocessing of CERES record).

5) Update software documentation and archive latest version of level 1-3 code that is used to produce ancillary input data used in production of CERES data products. This includes key validation code used in the process of creating the ancillary inputs.

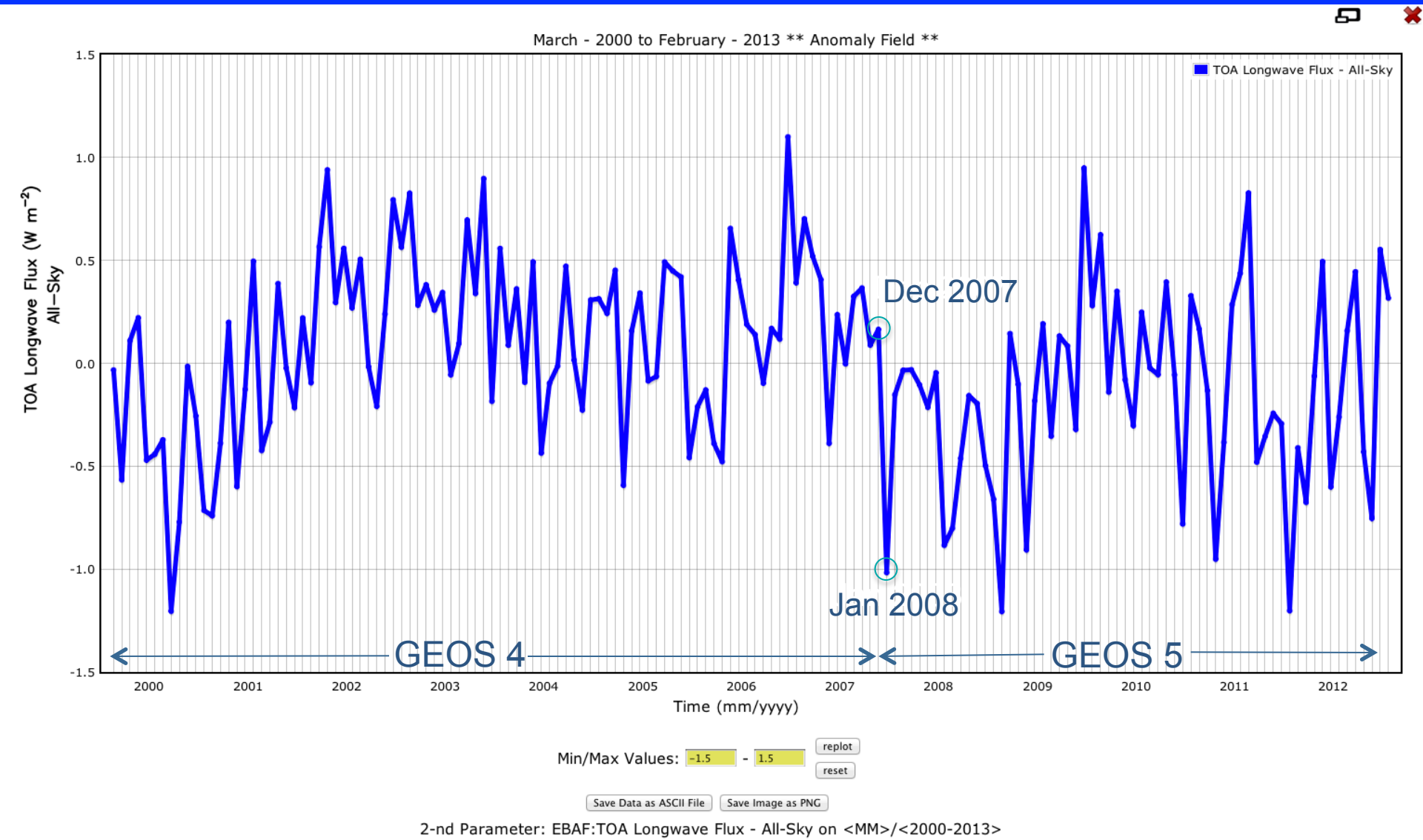
Terra and Aqua Edition 3 & 4 Planned Milestones

Product	Science Delivery to DMT	Target Public Release
Ed3 Flux-By-Cloud-Type	Oct 25, 2013	Dec 20, 2013
Ed4 Spec. Response func	Nov 1, 2013	N/A
Ed4 Inversion	Nov 22, 2013 (ADM & SOFA groups)	Feb 7, 2014
Ed4 SSF1deg-Hour	Feb 28, 2014	May 23, 2014
Ed4 SSF1deg-Month	Mar 31, 2014	Jun 27, 2014
Ed4 TSI	Feb 28, 2014	Aug 20, 2014
Ed4 SYNI	Apr 11, 2014	
Ed4 SYN1deg	Apr 25, 2014	
Ed4 ISCCP-D2like (all 3)	May 30, 2014	Aug 22, 2014
Ed4 CRS	Jul 31, 2014	Dec 22, 2014
Ed4 Flux-By-Cloud-Type	Sep 30, 2014	Nov 28, 2014

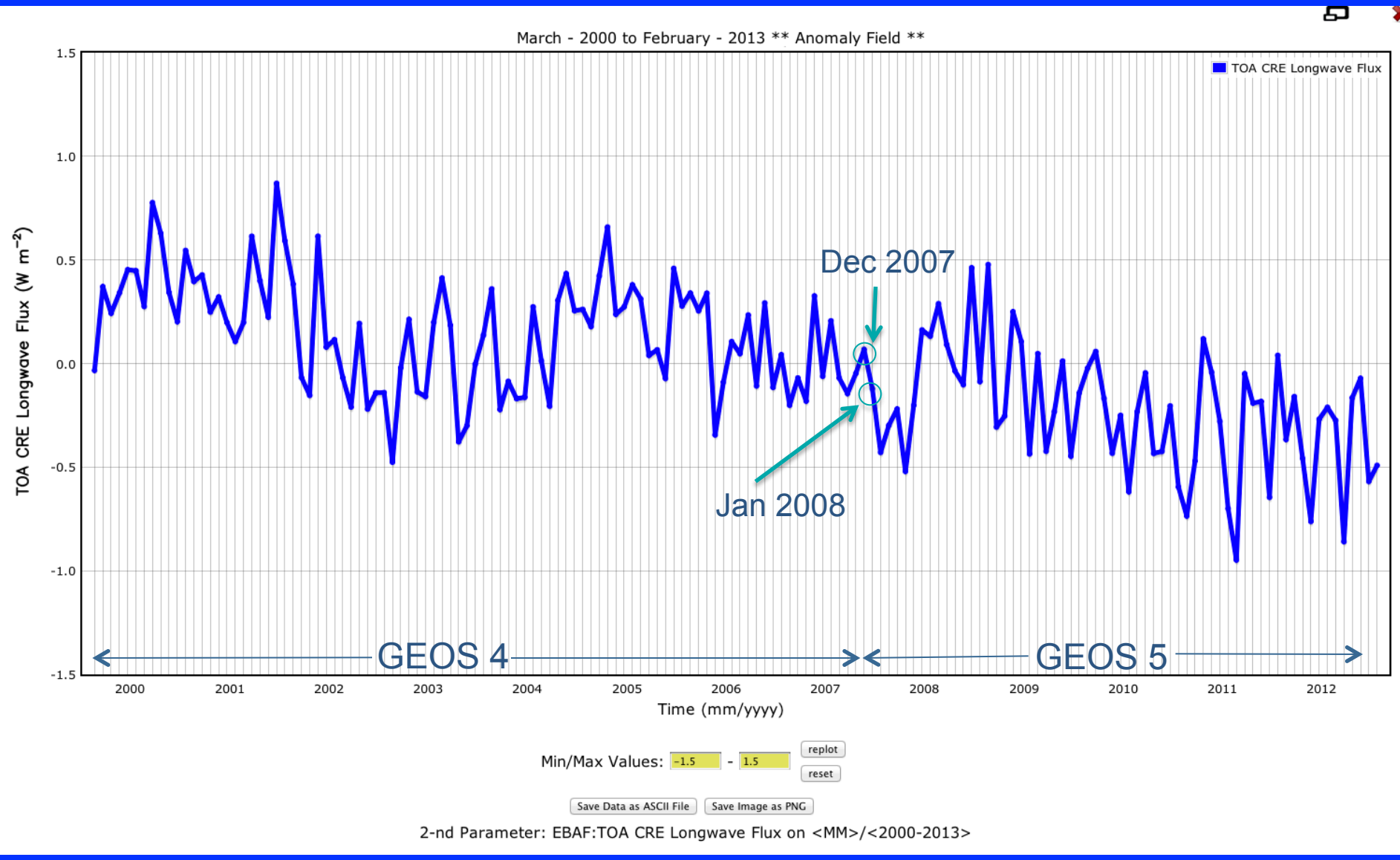
EBAF TOA **Clear-Sky** LW TOA Flux Anomaly (Global Mean)



EBAF TOA **All-Sky** LW TOA Flux Anomaly (Global Mean)



EBAF TOA LW **CRE** Anomaly (Global Mean)



CERES FM5 SNPP

- Calibrated VIIRS radiances from GSFC Land PEATE (Xiong) in April 2013.
- CERES Edition1 Cloud group delivery: ~~end of June 2013~~ November 22, 2013.
- CERES FM5 time-varying gains included in SSF Edition1 via “inversion-only” run
- Anticipate “MODIS-Like” VIIRS aerosols from Land PEATE in early 2014 (POCs: Rob Levy & Christina Hsu). Consider including in Edition2.
- Consider also using CriS for CO2 bands in Edition 2 ?

NPP Planned Milestones

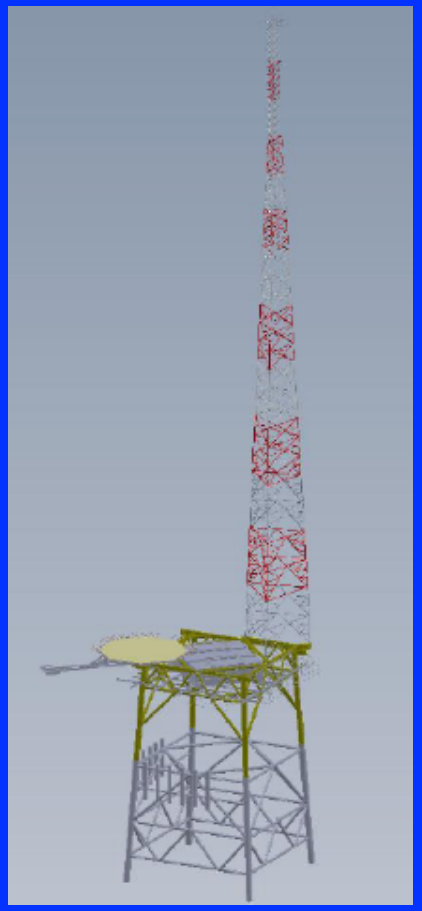
Product	Science Delivery to DMT	Target Public Release
Ed1 Clouds (SSF)	Nov 22, 2013	May 16, 2014
Ed1 SOFA Code (SSF)	Feb 10, 2014	
Ed1 Gains (BDS)	Nov 29, 2013	Dec 18, 2013
Ed1 SSF1deg-Hour	March 14, 2014	May 27, 2014
Ed1 CRS	March 24, 2014	May 30, 2014
Ed1 SSF1deg-Month	April 11, 2014	June 13, 2014
Ed1 SYNI	April 30, 2014	July 7, 2014
Ed1 TSI & SYN1deg	May 9, 2014	

Future Earth Radiation Budget Missions

- The current plan is to transfer responsibility for sustained climate measurements from NOAA to NASA.
- CERES FM6 to launch on JPSS-1 in Nov 2016.
  - CERES team to produce Earth Radiation Budget Climate Data Records using CERES FM6, closely following FM5/SNPP approach.
- NASA is studying the best options and approaches for economically providing RBI in time for the November 2021 launch of JPSS-2 spacecraft.
- Radiation Budget Instrument (RBI) Status:
  - Draft RFP released in April, 2013
  - Industry-Day April 30
  - Official RFP release: June 14
  - Award: Spring 2014
  - RBI delivery date: Spring 2019.
  - Launch on JPSS-2: November 2021.

COVE

- DOE purchased Ches Light to create RFORE -- Reference Facility for Offshore Renewable Energy.
- If RFORE continues to stay on track, offshore construction will begin Summer 2015.
- The 100 m tower will be instrumented with precision anemometers, barometers, and thermometers.
- One or more wind profiling lidars or radars are also planned.



- COVE BSRN instruments and Cimel will be located on top of the new tower.
- COVE in situ instruments and MFRSR will be located near helopad level, and possibly a 2nd BSRN tracker and Cimel.
- COVE MPLNET will either be located at helopad level or removed and located on CAPABLE site at LaRC.

- Meanwhile, the COVE project is still collecting data.
- After a DOE-mandated safety hiatus (Nov 2012 to July 2013), COVE systems are fully operational again.

Upcoming Conferences & Meetings of Interest

Fall American Geophysical Union
- December 9–12, 2013, San Francisco, CA

94th AMS Annual Meeting
- February 2–6, 2014, Atlanta, GA

Spring CERES Science Team Meeting
- April 29–May 1, 2014, NASA LaRC

European Geophysical Union General Assembly
- April 27–May 2, 2014, Vienna, Austria

14th AMS Conference on Atmospheric Radiation & Cloud Physics
- July 7–11, 2014, Boston, MA

IGARSS 2014
- July 13–18, 2014, Quebec City, Canada

7th International Science Conference on the Global Energy and Water Cycle
- July 14–17, 2014, The Hague, The Netherlands

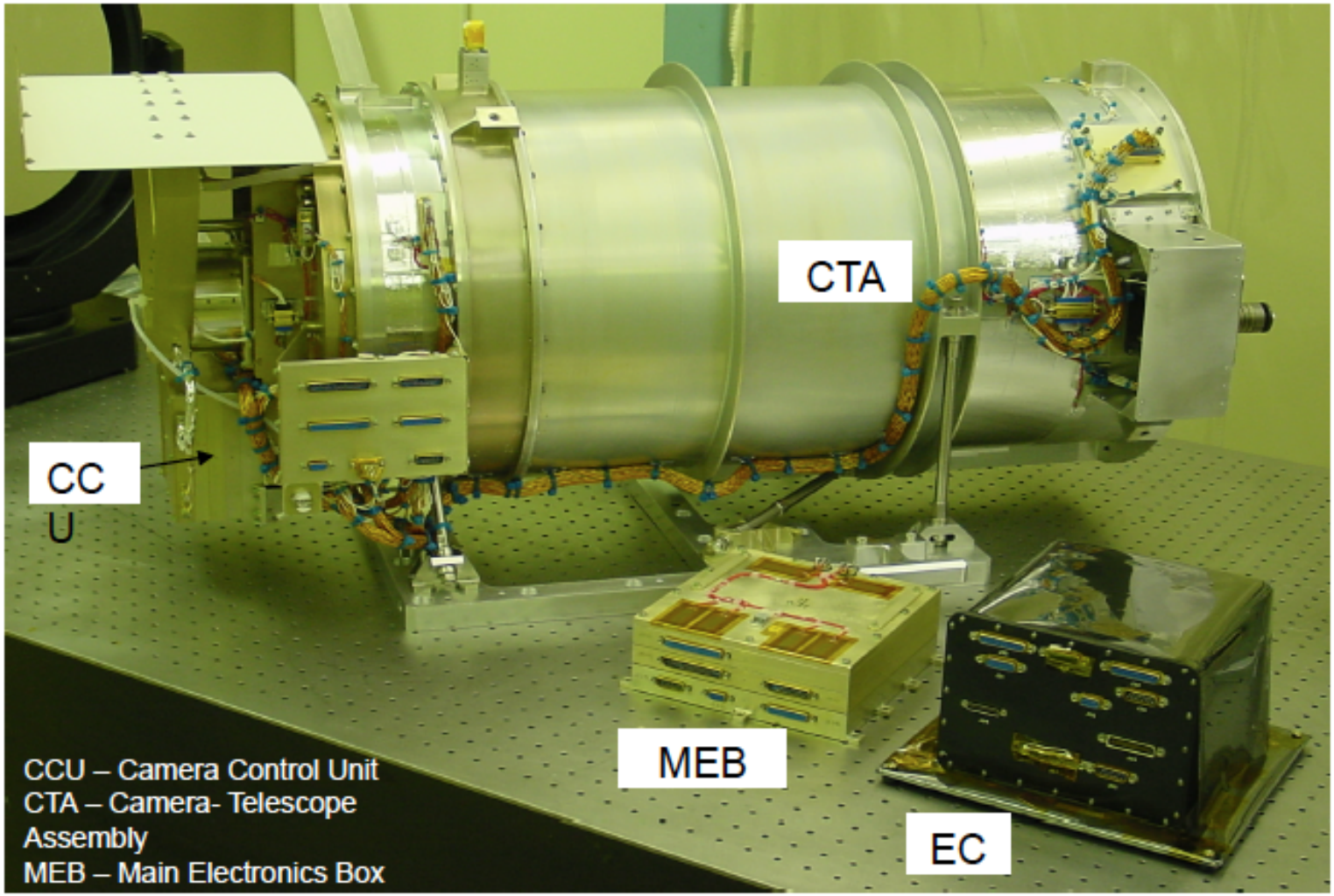
Other News

- SORCE spacecraft (launched Jan 2003) is currently operating in an 'emergency' mode due to the loss of another battery cell.
- There is currently no data beyond July 30, 2013.
- SORCE team is preparing the spacecraft software & operations to support a campaign to ensure overlapping measurements between SORCE and Total Solar Irradiance Calibration Transfer Experiment (TCTE) in December 2013.
- TCTE: Total Solar Irradiance Calibration Transfer Experiment.
  - Will fly onboard a U.S. Air Force Space Test Program spacecraft.
  - Launch date: November 4, 2013
  - Launch location: Wallops Island, Virginia
  - Launch vehicle: Minotaur I
  - Mission duration: 18 months
- Following the intercalibration campaign, effort will focus on returning SORCE back to continuous (daily) science data acquisition.
- CERES team is evaluating RMIB TSI composite (mainly DIARAD/VIRGO instrument on SOHO) as alternate source of solar irradiance data.
- CALIPSO – Functioning nominally
- CloudSat – Returned to the A-Train. Nominal Daylight Only Operations (DO-Op) continue.

Other News

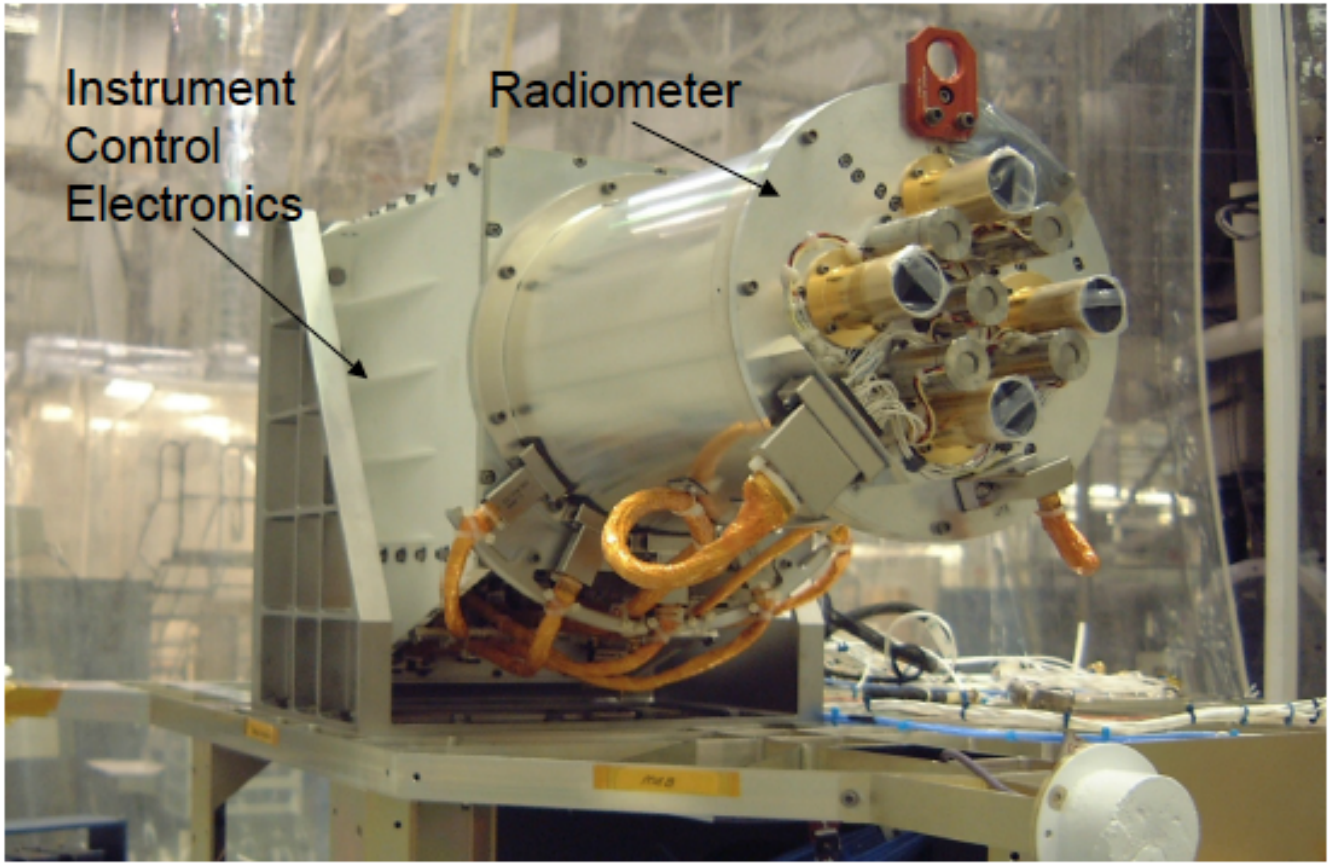
- Deep Space Climate Observatory (DSCOVR) is to be launched in early 2015.
- Positioned at the Sun-Earth L1 Lagrangian point (1.5 million kilometers from Earth) to provide early warning of approaching solar storms. It will also have a continuous view of the sun and the sunlit side of the Earth.
- Earth-Viewing Instruments: EPIC (spectral imager; 8-14 km spatial resolution); NISTAR (broadband; full view of sunlit side of Earth).
- The DSCOVR mission is a partnership between NOAA, NASA and the U.S. Air Force:
  - NOAA will operate the DSCOVR mission.
  - NASA refurbished DSCOVR satellite and instruments. Is developing the ground system.
  - The U.S. Air Force is providing the SpaceX Falcon 9 launch vehicle for DSCOVR mission.

Earth Polychromatic Imaging Camera (EPIC)



Global spectral images of the sunlit side of the Earth.
Wavelength spans ultraviolet and near infrared.
4 megapixel CCD sensitive over entire wavelength with 8-14 km resolution.

NIST Advanced Radiometer (NISTAR)

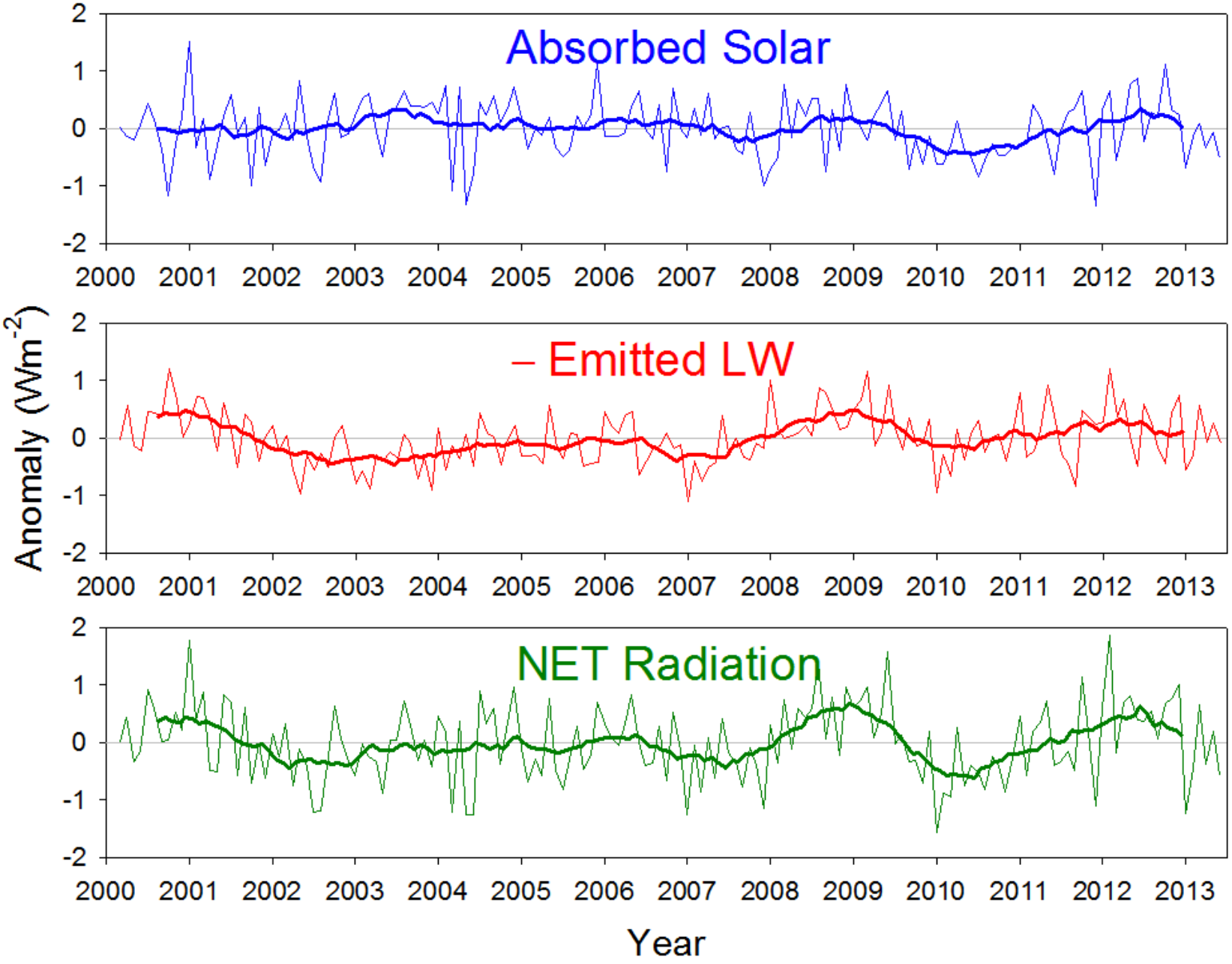


Earth radiation data from 4-channel Radiometer

- visible to far infrared (0.2-100 μm) channel to measure total radiant power in UV, visible, and infrared wavelengths
- solar (0.2-4 μm) channel to measure reflected solar radiance in UV, visible and near infrared wavelengths
- near infrared (0.7-4 μm) channel to measure reflected IR solar radiance
- photodiode (0.3-1 μm) channel for calibration reference

End

Global TOA **All-Sky** Radiation Anomalies
(CERES_EBAF_Ed2.7; 03/2000 – 06/2013)



Upper Ocean Heating Rate and Net TOA Radiation (Annual Mean)